Read Nuclear Physics Today

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A SCIENCE SERVICE PUBLICATION

New Ideas Wanted

As THE FIRST decade of the atomic era is completed, recognition of the constructive possibilities of atomic power is becoming more and more widespread. Ten years ago the possibility of harnessing atomic fission was still an enigma. Today both atomic fission, obtained from a very few of the heaviest isotopes, and atomic fusion of the lightest element, the force that kindles the stars, are known to man.

Ten years ago the laws of the formation of isotopes by radioactive bombardment of atoms were very imperfectly understood. Now elements are transmuted according to known laws and the properties and half lives of isotopes not yet in existence can be predicted.

Fear of unknown reactions has been replaced by a healthy respect for known dangers, but ways to avoid these dangers have been learned. Automatic controls for atomic reactors have been worked out. Shielding materials have been improved. Now we are ready to begin to apply this new, strange force to some of the work that needs to be done.

Experts in this new science tell in several of the articles in this issue of CHEMISTRY how different the conditions are in this new realm from those counted on by engineers building and operating ordinary power plants. Every substance they handle now has a new dimension which they must take into account — its cross-section for neutron absorption.

Need for elements with unique nuclear behavior sends prospectors looking for beryllium and stimulates metallurgists to solve the baffling problems of zirconium. Accumulation of once-rare atomic species among the fission products challenges the ingenuity of chemists to find uses for strontium and neodymium. Everywhere problems await those who like to try something new. Any ideas?

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—U.S.D.A. Bureau of Plant Industry photo.

➤ RADIOACTIVE *superphosphate fertilizer tells the soil scientist with the Geiger counter how much phosphate the Spanish peanut plants take up from the soil and how soon the effect of the fertilizer appears in the growing branches.*

Nuclear Physics Today

by DR. JOHN R. DUNNING

Dean of the School of Engineering, Columbia University

Columbia University is celebrating the two hundredth anniversary of its founding. As part of this celebration Dr. Dunning made the first lecture in a series entitled "Explorations in Modern Science." This is the written version of his lecture.

➤ MANY significant events are taking place today in science and engineering which are bound for wide application fifty years from now, just as the basic researches of fifty years ago now mean much in terms of man's current progress. The foundation of much of our

industrial progress was being laid a half century ago. The developing atomic concepts of matter have laid the bases of our chemical and metallurgical industries. The X-ray of Roentgen gave us a powerful tool for insight into the nature of matter. The electron of J. J. Thompson, also approximately fifty years ago, led to today's communications industry.

Tools for Research

The X-ray is a valuable tool in basic research in solid state physics, the importance of which is rapidly growing as a tool for medical researchers and for metallurgists and chemists as well as physicists. The discovery of radioactivity itself, approximately a half century ago, led to the development of the study of nuclear physics, which will have important impact on our whole civilization. Dr. Einstein's relativity theory of 1905 opened up new areas of study, although it has subsequently been expanded as a result of basic findings in research.

Recent discoveries in the physical sciences will form the basis and the background for future research, which, in the foreseeable future, will be directed toward further understanding matter and energy. This matter and energy represented in the atom are the basic raw materials in providing man with a more highly industrialized civilization than he has ever known before.

Fifty years ago the atomic nature of matter was just being accepted. Investigations into the internal structure of the atom by physicists have led to the knowledge of how atoms can be put together to make many new compounds and substances. Thus the basic atomic research has led to the establishment of whole new industries in the chemical, metals and biological fields. The whole development of our American economy over the past half century has been based on scientific research translated through technology to the vast production of our industries. This relationship between the basic scientific laboratory, applied research and production forms the major framework upon which our continuing industrial revolution continues to build.

As a matter of fact, we are just beginning to capitalize on our basic findings in science. The possibilities of research are just beginning to be fully understood by persons in business and industry. We are just beginning to move forward with a dynamic economy based on knowledge in these fields.

Sources of Energy

As we continue on the road in this atomic age, the basic inquiry that will continue to be carried on in the nuclear physics and chemistry laboratories of the world, will undoubtedly result in our tapping more and more primary sources of energy, even to solar energy itself. Researches in the atomic field already are beginning to make their possible applications felt in our everyday life, through medicine, through the preservation of foods, in the use of radioactive tracers, in the establishment of nuclear power plants. The application of the facts and forces now being discovered within the atom, will come more and more quickly as our technology develops the machinery for its use. Large ship propulsion fifty years from now may be largely atom-powered, for instance. And, as we learn more and more about the atomic nucleus as new nuclear ma-

➤BURIAL *to prevent escape of the radioactivity sealed up in its walls will soon be the fate of Building D, one of the oldest laboratories at Los Alamos. Here the first pieces of plutonium readily visible to the naked eye were fabricated, and the nuclear parts of the first three atomic bombs were made. Alpha-emitting contamination on its walls has been covered by wall-board and paint in the course of the years. Now the Health Division has accumulated enough experience with disposal of radioactive wastes to assume the monitoring of the wrecking job, with assurance that it can be done safely.*

chines and techniques for such research become available, more and more areas for the use of what is learned in atomic research will open up.

The results of inquiry into the atom will undoubtedly be the most important development not only in the next fifty, but in the next one hundred years.

Where are we now in our basic quest to put the atom to work?

Putting the Atom to Work

The thousands of scientists and engineers in universities, industries and special laboratories have made very substantial progress. The A.E.C.'s own reports, the growing volume of publications in our scientific and professional journals, the expansion of nuclear engineering education and research in our universities and the growing contributions of the industry study teams plus the thousands of private contractors, universities and industries, with the A.E.C., all testify to rapidly growing atomic science and technology bursting with vigor and ready to move with increasing speed in many areas.

All present atomic reactors necessarily result in a large percentage of the energy output as more or less instantaneous heat, hence virtually all applications for reactors involve the use of atomic heat in much the same ways as coal, oil or gas are utilized to heat a working fluid such as water (steam) or gas for a gas turbine. That excess neutrons are present, together with other radiations, opens up by-product processing possibilities. Furthermore, the ashes of nuclear fission are the fission products which have useful energy and properties, on one hand, and which must be removed within limits to minimize "poisoning" the chain reaction and to maximize the "burn-up" of the atomic fuel. Partially spent fuels must generally be "cleaned up" and often upgraded by new fuel or by enriching in a gas diffusion plant.

All atomic reactors therefore involve fuel and chemical processing problems of fuels, fertile materials and "fission ashes" that are inescapable. In addition the ash disposal problem involving "hot fission" products must be handled with public safety in mind as well as the safety of operating personnel. All of these operations are major cost items and offer great rewards for future development and simplification.

Atomic reactors clearly have a whole range of possible types and applications. This wide range of special uses has caused some confusion.

The only fissionable atom in nature with slow neutrons is U-235, found in all natural uranium to 1 part in 140. This isotope may be used in the appropriate reactor design to produce a chain reaction either in the natural 0.7 per cent concentration as in the early Hanford type graphite moderated reactors, or in enriched form.

Gas Diffusion Process

The successful development of the gas diffusion process for concentrating U-235 in the huge Oak Ridge, Tennessee; Paducah, Kentucky; or the new Portsmouth, Ohio, plants makes possible the efficient production of atomic fuel of any desired concentration. U-235 in pure form represents our primary fission fuel, at a cost which earlier A.E.C. statements indicate to be around $9,000 a pound for

an energy content equivalent to around 3,000,000 pounds of coal.

Although the basis for this U-235 cost figure or its current value has not been made clear, the significant point is that a pound of fissionable fuel in its most expensive pure form as U-235 costs about the same as $6 per ton coal! In its most expensive intrinsic form, U-235 atomic fuel is on this basis cheaper than coal even in U. S. at points any distance from coal mines, and much cheaper than coal in many parts of the world. This is a very significant factor in assessing the future economics of atomic energy.

Another important point for future atomic development is by-product "breeding" of new fissionable fuel atoms. For every neutron which hits a U-235 nucleus and causes fission energy release two to three new neutrons are liberated. Only one neutron is necessary to go on to fission another U-235 atom on the average to keep a chain reaction going. The remaining one to two excess neutrons, allowing for losses, are available for by-product reactions such as combining with "fertile materials" like U-238 to form Plutonium 239 or Thorium to produce Uranium 233. Such new synthetic atoms are essentially equivalent to the original U-235 for fuel purposes; therefore, we can produce *more new atomic fuel atoms than we burn* in a "net gain power breeder" reactor, and this has been demonstrated. Obviously, this breeding gain offers possibilities for large reductions in atomic fuel costs over using pure U-235 and at the same time increases the potential atomic fuel supply reserves by a factor up to 140 times for burning U-238 by conversion and in addition, a somewhat less known factor for thorium by conversion.

On this basis present known world uranium reserves indicate a potential world atomic fuel reserve at least 25 times greater than our fossil fuel supply in the forms of coal, oil, or gas. Almost certainly this figure will increase as the world-wide search for uranium ores, cheaper mining and processing methods goes forward.

Atomic fuel supplies therefore represent by far the largest source for the world's future energy. The possible exception is solar energy whose technology and economics are by no means developed or even partially clear.

Need for Atomic Power

With the world's oil and gas reserves already sharply limited, and the easily minable high quality coal reserves already significantly reduced, the world simply must inevitably turn increasingly to atomic energy for the power to make a reasonable standard of living possible.

The future must and will inevitably belong to the rapidly growing progress toward utilizing the enormous possibilities of the atom in every constructive phase of human activity. President Eisenhower's positive proposal last winter before the U.N. for international cooperation in utilizing the atom received the approval and commendation of all scientific and engineering groups in the U.S. as expressed in the meeting of the American Association for Advancement of Science in Boston representing over two hundred societies. Science knows no national boundaries and welcomes the opportunity to cooperate with our

colleagues in other countries for the good of mankind.

Some fifteen years have elapsed since the discovery of the energy release in uranium fission in January, 1939, and we are now in the second decade since the first self maintaining chain reaction. Back of all the present progress in the atomic field are the patient efforts and occasionally brilliant discoveries of thousands of workers in many laboratories all over the world. In a larger sense, atomic energy is simply one of the striking symbols of man's long search for knowledge—knowledge of the world around him and knowledge of man himself. The progress of man is largely a matter of how we use this slowly won knowledge to build the kind of world we want. Knowledge by itself is neither good nor evil. The real question is how we use that knowledge which is the indispensable tool we must have to solve the world's problems.

On the Back Cover

➤ IRON WHISKER, *seen through the microscope, is flanked by a pin head on the left and a manipulating wire on the right. Grown by a process of vapor deposition in the research laboratories of the General Electric Co., this perfect crystal shows the enormous strength predicted for iron by theory but not heretofore found. This inch-long crystal, about one thousandth of an inch thick, was grown by Dr. Robert L. Fullman and Arno Gatti. It was described by Dr. C. G. Suits, director of research for G.E., in an address at Omaha, Nebr. He stated that such crystals are not only 100 times as strong as any known metallic crystal, but that they are resistant to rust. "The same atomic perfection that gives them strength," he explained, "prevents oxidation."*

Experimental Reactors Built For Power Costs

New Atomic Reactors Speed Use

Extracts from an address by Dr. Henry DeW. Smyth to the national meeting of the American Institute of Chemical Engineers, at Washington.

▶ THE FIRST of the new reactors was the so-called materials testing reactor, MTR. It was aimed primarily at getting information on the effects of radiation on uranium fuel elements or other materials that might be used as tubes for cooling water, or as coolants, or containers for uranium fuel elements. The object of this reactor then was to provide very high intensity radiation in a machine so designed that many experimental samples could be placed in it. It has now been running for about two years, and it has in fact proved exceedingly useful. Incidentally, it also was a novel kind of reactor and therefore was in itself a step toward the development of new types of reactors.

The second reactor built at Idaho was the so-called experimental breeder reactor, EBR. As the name implies, it was specifically aimed at demonstrating whether or not breeding was possible. It has demonstrated that breeding is possible and has had a number of other incidental interesting results.

The third reactor was a special purpose one aimed at providing power for a submarine. You have heard a great deal about that one and about the submarine in which a similar reactor is now being installed.

In all three of these reactors, the neutron economy problem was solved by using uranium from which much of the uranium 238 isotope has been extracted. Whether or not in the long run, this is the kind of reactor we will build for power purposes will be largely a question of economics. Personally, I doubt it, but I do not doubt the wisdom of having built these three reactors and the value of the results we have obtained from them.

A more modest undertaking initiated later is the homogeneous reactors experiment at Oak Ridge. From the atomic point of view, the homogeneous reactor is misnamed. In reality, one can think of it as a lattice where the spacing is very small and the size of the fuel elements is of atomic dimension. To put it more simply, and in terms that will be more familiar to you, the homogeneous reactor is a solution of uranyl sulphate in water. The water serves as the moderator, and the uranyl sulphate molecules serve as the fuel elements in which the chain reaction is set up.

The immediate and obvious advantage of the homogeneous reactor is that fuel fabrication and processing is enormously simplified. The solution is pumped continuously through the reactor chamber and then cooled in outside heat exchangers, and some of it can be continually led off for purification and then re-introduced into the circulating stream of combined fuel and moderator. One of the interesting features of the homogeneous reactor is that it turns out to be self-

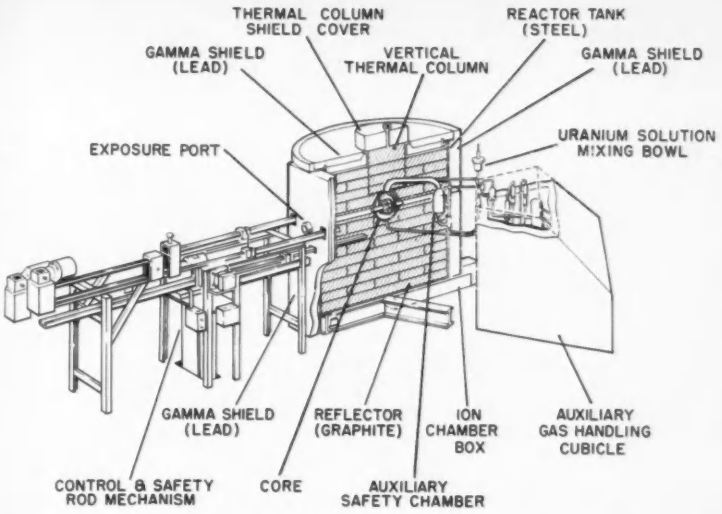
regulating. As the temperature of the reactor rises, its reactivity decreases and therefore it controls itself. One difficulty that was anticipated in the homogeneous reactor was that the water itself would be dissociated by the radiation. This does occur, but it has been found possible to recombine the hydrogen and oxygen formed without too great difficulty.

In addition to the results obtained with the three reactors I have been discussing, and the homogeneous reactor experiment, there has, of course, been an extensive program of study of the various associated problems in the laboratory. These range from fundamental studies of what causes radiation damage, or of the absorption probabilities of various materials for neutrons of various energies, to component testing in heat loops, and experimental fabrication of fuel elements. Some of these studies use the various low-power research reactors that have been built.

One of the most interesting experiments that has been done was carried out last summer at the Idaho Test Site by Dr. Zinn, director of our Argonne Laboratory, and his associates. We had long worried about what would happen to a water-cooled reactor if the flow of water should be cut off. We were afraid if the water supply was cut off or if the temperature of the reactor rose too rapidly boiling would occur and that this might have disastrous results. Dr. Zinn decided to make a direct approach to this problem and built a small reactor with the deliberate intention of producing boiling. When it was set up at the Idaho testing station, it had an arrangement in it which suddenly ejected the control rods so that the power generated by the chain reaction went up in a fraction of a second from a few watts to many thousands of watts. This had the expected effect on the water. It boiled. It boiled so violently in fact that it was ejected from the reactor in a small geyser. Repeated trials showed that in every case the boiling reduced the power of the reactor so rapidly that no serious damage was done.

This particular experiment illustrates very well the reasons for choosing an isolated area as a site for experimental reactors. It was not only that some of the reactors might be inherently dangerous, but it was felt that an experimental reactor, one built primarily for the purpose of obtaining information, should be operated to extremes, and that it was desirable to have them in an isolated location for that reason. In other words, if you want to get as much information as you can out of a reactor, you need to push it to the point where it might conceivably run into trouble.

Let me summarize some of the major results that we have obtained in the last five years either directly from the reactors we have built and operated or from laboratory work. I will take them in terms of the five general areas that I enumerated at the start. So far as neutron economy is concerned we have learned a great deal about the probabilities of various nuclear events, including the relationship between the probability of fission and the energy of the neutrons. (This, for example, was tested in the experimental breeder reactor.) We have found that we can use a number of different substances as moderators, specifically beryllium, light water, and

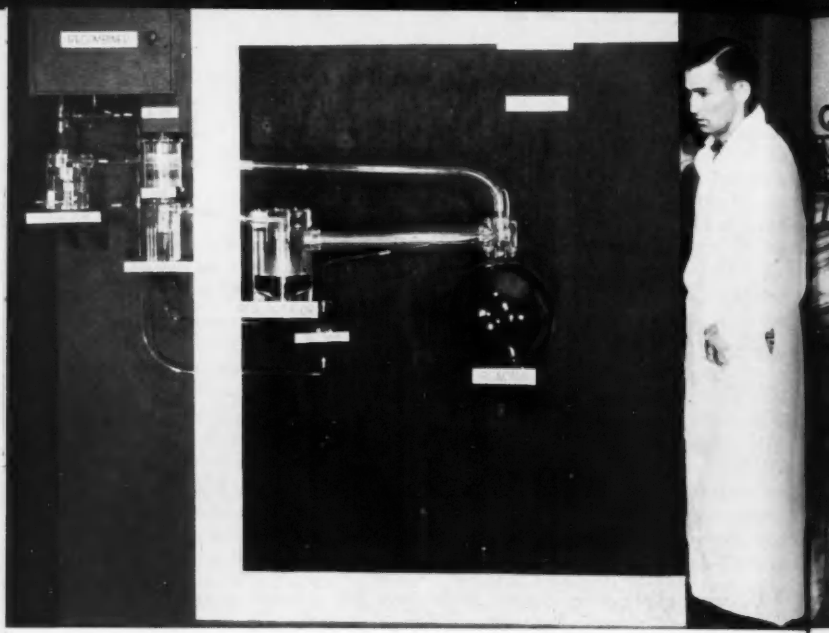


➤ DRAWING *of the essential parts of the water boiler atomic energy reactor now in use by the California Research and Development Co. Four gallons of uranyl sulfate solution in the center spherical core fissions to give off neutrons. The heat evolved boils the water, hence the name of the reactor. It has the unique feature of not emitting fumes.*

heavy water in addition to the familiar graphite.

As to the effects of radiation, the MTR has, of course, been of the greatest value as one might expect since it was designed for that purpose. But we also have the benefit of studying the fuel elements that have been in the EBR and in the submarine thermal reactors. These, too, have been valuable. We have made a great variety of alloys and have tested various fuel elements. In particular, the submarine thermal reactor has shown that fuel elements sheathed in zirconium will resist corrosion and radiation effects over considerable lengths of time and represent a great improvement over the aluminum sheathed fuel elements in the Hanford reactors. Radiation effects have also been studied in a variety of coolants including sodium and heavy water.

In the matter of heat transfer we have found we can remove the heat from a reactor by circulating molten sodium-potassium alloy through it. This is the system of heat removal used in the EBR. We have also done a great deal of work on pure sodium as a possible coolant and are using it in the second type of submarine reactor now under construction. We have also found that we can use a



➤ DESIGN *of the "percolating tea kettle" or water boiler type of atomic energy reactor built for the Atomic Energy Commission by North American Aviation, Inc., and now in use by the California Research and Development Co. at Livermore, Calif. This mock-up in laboratory glass ware outlines the principal parts of the novel reactor.*

cooling system of pressurized water. This is the system used in the submarine thermal reactor. We have run reactors at much higher temperatures than we were ever able to run them at Hanford, and therefore, we have moved in the direction of efficient use of the energy from nuclear fission.

As to control and instrumentation, the most striking results have been those already mentioned where we have found that certain types of reactors are in fact self-regulating as a result of boiling or near boiling as the temperature rises. The only other result I will mention is the use of hafnium as a material for control rods. Hafnium is present as an impurity in zirconium and has to be removed before zirconium cladding can be used for fuel elements because it absorbs neutrons. For the same reason it is very useful as a control material.

In the matter of chemical processing, perhaps it is fair to say that most of the work has been accomplished in the laboratory, although we have had experience with actual processing of the various types of fuel elements in the new reactors, none of which is

➤ APPARATUS *built to try out the new design of atomic energy known as the water boiler or "percolating tea kettle." The sphere contains uranium 235 which fissions to give out a high density of neutrons. The action of the reactor was first planned out in the mock-up shown on the opposite page.*

exactly like those at Hanford. We have also proved that the homogeneous reactor will work, at least on a small scale, and we, therefore, know that that is one direction in which to hope for improvement.

In the matter of costs, we still have much work to do. None of the reactors we have actually put up is cheap, either to build or to operate. The submarine thermal reactor probably costs somewhere around fifteen hundred or two thousand dollars per kilowatt to build, which is to be compared with the cost of a modern steam plant somewhere around a hundred and eighty dollars per kilowatt. But the submarine thermal reactor does prove one over-all major result; namely, that it is possible to build a reactor for the production of power that will run for at least reasonably long times continuously and efficiently.

The fundamental question still to be answered is whether a power producing uranium reactor can be built which will compete with other sources of energy. The answer to that question will be found in the choice of some one of the kinds of reactors we have already built or thought about. None of them has yet been proved to be the

ideal or even the best choice. The homogeneous reactor, for example, does simplify chemical processing, but it requires enriched fuel and it is not yet certain that the corrosion problems can be solved. The breeder has not yet been proved on any large scale so that we do not know at all how expensive that may be. The submarine thermal reactor uses such expensive materials for cladding the fuel elements that it is almost certainly not competitive, even though we may be able to produce zirconium at lower and lower costs. It also uses enriched material. And so it goes all through the list.

In the last few months we have been reviewing the results that we have obtained up to the present time and planning what would be best to do over the next few years in order to arrive at an economical solution of the problem of nuclear power. We have decided that there are six programs that we should pursue. One of these is the general program that we must obviously continue, the program of research on fundamental properties of materials, on nuclear reactions, on components that might go into the reactors of the future and on chemical processes. This work will be continued principally in our Argonne and Oak Ridge laboratories. In addition to this general research and development work, we wish to build five reactors of varying size and cost. The Commission has recently submitted to the Joint Committee on Atomic Energy a special report on the reactor program prepared at the request of the Committee.

The first of these reactors in our new program has already been publicly announced. It is the so-called PWR reactor which is designed to generate at least sixty thousand kilowatts of electric power. It will use slightly enriched uranium as fuel, ordinary water as a moderator and coolant. The reactor will be operated under reasonably high pressure and temperature, not nearly so high as are used in modern steam plants, but as high as we feel safe in terms of our present knowledge. Specifically, the water in the reactor will be under two thousand pounds per square inch pressure and at a temperature between 500 and 600° F. Steam will be delivered to the turbine at about 600 pounds per square inch. The temperature is limited by the corrosion of the fuel elements and piping and container, and the pressure is limited by the strength and size of the vessel in which the reactor must be contained. One of the difficult problems in this reactor will be that of getting control mechanisms to operate in a high-pressure vessel. Principally, we hope to learn from this reactor how such a plant may stand up under ordinary operating conditions of central station electric power plant and how much it costs to build and operate it. We have no expectation that this reactor will produce power as cheaply as a modern coal burning plant, but we hope to learn how costs can be cut in later plants.

The second new reactor which we wish to build is a breeder of intermediate size. It will not be of direct interest from the point of view of economic power, but it will be much larger and much more nearly a power producing, continuously operating reactor than the small experiment we have been running out in Idaho. The scale-up planned is from 1,400 to 62,

500 kilowatts of heat, and from 170 to 15,000 kilowatts of electric power. Temperatures and steam pressure will be increased to values appropriate to a full scale power breeder reactor. Auxiliaries such as pumps, heat exchangers, valves, etc., will be of sizes suitable to a full scale reactor.

Our third step is based on the boiling experiment that I have already described. It will be an attempt on an intermediate scale actually to use boiling of the water as a method of heat extraction. We hope in this way to get a very cheap method of getting the heat out of the reactor and possibly of eliminating one step between the coolant in the reactor and the turbines which turn the generator. It is planned to feed the steam generated in the reactor directly to the turbines. Present plans call for 20,000 kilowatts of heat and 5,000 kilowatts of electric power.

The fourth reactor which we intend to build is a larger version of the homogeneous reactor. Again, it will be a step in the direction of a practical power producing unit and should give us information about corrosion, chemical processing, and operating conditions that cannot be obtained with the small machine now in use at Oak Ridge. Present specifications call for only 3,000 kilowatts of heat in this reactor experiment compared to 1,000 in the present experiment. The next step, already planned, calls for 65,000 kilowatts of heat in a homogeneous reactor which will breed uranium 233 in a blanket of thorium surrounding the chain reacting core.

The fifth reactor experiment which we plan to build is a little different from any that I have described. I have mentioned that the breeder reactor uses sodium-potassium alloy as a coolant. You all know that the Hanford reactors use graphite as a moderator. We hope to be able to combine these two materials, getting the advantage of high temperature without high pressure from the sodium coolant. To test this combination, we will build a reactor generating about 20,000 kilowatts of heat but without any electric generating plant attached.

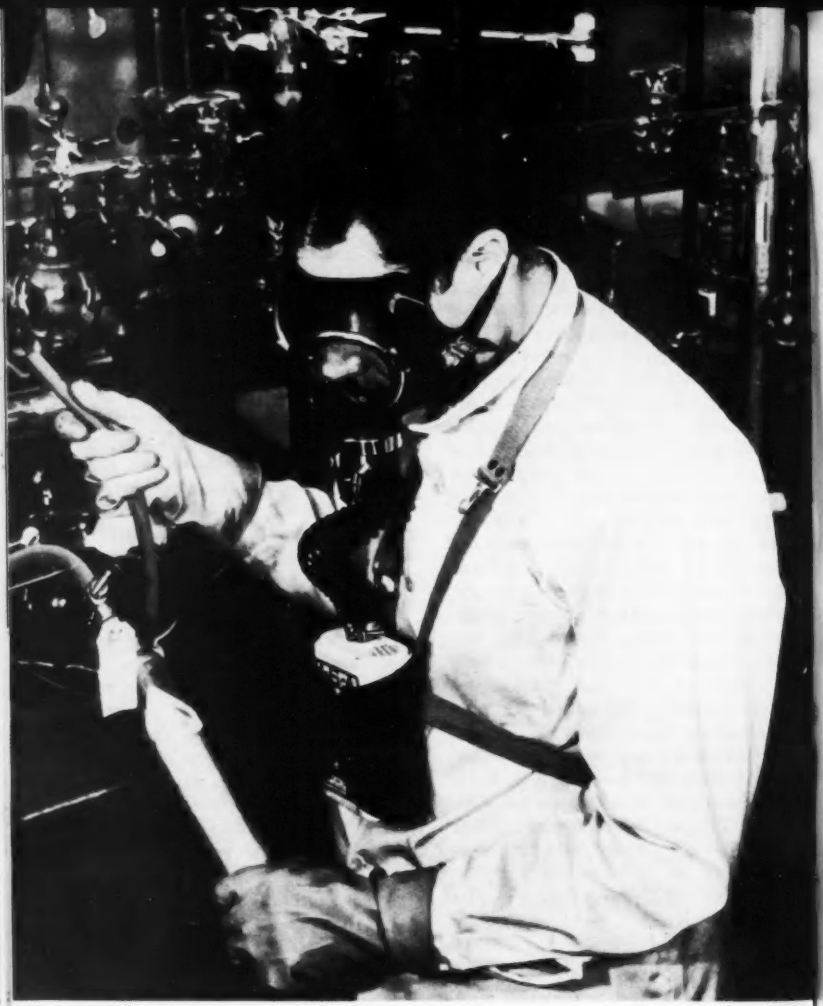
In addition to these new proposals, we shall continue several other programs already under way. These include the so-called intermediate submarine reactor now under construction at West Milton, New York, near Schenectady, and the development of a reactor to propel aircraft. Though the aims of both of these projects are special, they will undoubtedly contribute to the general technology.

X-Ray to Study Metal Brittleness

▶ THE CAUSE of brittleness in steel and other metals at low temperatures is being explored by Dr. Daniel Rosenthal and Murray Kaufman of the University of California at Los Angeles engineering department.

They have developed a special low temperature X-ray diffraction apparatus to study the crystalline process by which some metals become brittle at low temperatures.

A super freeze is maintained by circulating liquid nitrogen through a tubular specimen which is being rotated under a load. X-ray pictures of the deformation of the specimen are recorded by a special camera attached to the apparatus.



➤ SAFETY *clothing designed to protect people working with radioactive materials is worn by an aide in the engineering research division of New York University as he prepares chemicals for use in Geiger counters. Both the acid-resistant clothing and the industrial gas mask are produced by the Mine Safety Appliances Co.*

New Vision Chemical May Help to See Red

New Light on Chemistry of Vision

➤ CREATION of a new vision chemical for daylight seeing, which may even be the red-seeing chemical of the eyes, has been announced by Drs. George Wald, Paul K. Brown and Patricia H. Smith of Harvard University.

The chemical is a light-sensitive, blue substance called cyanopsin. It has not yet been extracted from any eye retina. But it could be expected to exist in the eyes of freshwater fish or any eyes that contain a special form of vitamin A and two other vision chemicals, retinene 2 and cone opsin. Cone opsin comes from the cones which are the cells of the eyes which operate in daylight.

Dr. Wald and associates made the new vision chemical, cyanopsin, from an extract of dark-adapted rods and cones from chicken eye retinas. This contains a mixture of two chemicals, rhodopsin and iodopsin.

Deep red light was used to bleach the iodopsin to a mixture of all-trans retinene 2 and cone opsin. To this they added a small amount of the specific cis isomer of retinene 2. In this way cyanopsin is synthesized within five minutes in the dark at room temperature.

This new pigment plays a part in the daylight seeing of freshwater fish, tortoises and American turtles, the Harvard scientists believe, because, even though it has not been extracted from any eyes, the eyes of these animals contain the chemicals necessary for its formation.

Because cyanopsin absorbs light waves far into the red part of the spectrum, Dr. Wald suspects that it may be the eye chemical with which the color red is seen. It is the first eye pigment which could serve in a "red receptor," he states.

With two other previously known visual pigments, rhodopsin and iodopsin, it might form the basis for a system of three color vision. But so far, Dr. Wald says, there is no evidence that this is the case.

Helps Eyes See at Night

➤ RESEARCH showing how a hormone from the pituitary gland helps eyes adapt to see in the dark is reported by Dr. Toshimasa Hanaoka of Nara Women's University, Nara, Japan, in the scientific journal, *Nature*.

The hormone is called the melanophore hormone, meaning that it deals with pigment formation. Injections under the skin of a highly purified fraction of this hormone, Dr. Hanaoka found, shorten the time it takes a person to adapt his eyes to seeing in the dark.

To learn more about how the hormone achieves this effect, Dr. Hanaoka carried out laboratory experiments with the hormone and the visual purple extracted from frog eyes. The visual purple is a light sensitive chemical in the eyes which is bleached by yellow light and is sometimes called one of the chemicals of vision.

The melanophore hormone helped

the regeneration of the visual purple after it had been bleached. Some of the experiments suggest the existence of a factor which cooperates with the melanophore hormone very effectively. Dr. Hanaoka is now investigating this aspect of the problem.

Gave Eyes to Science

➤ RECENTLY a man lost his eyes—but science gained new information on seeing in the dark, Dr. Frederick Crescitelli of the University of California at Los Angeles zoology department and Dr. H. J. A. Dartnall of the Institute of Ophthalmology, London, England, report.

The process of vision-in-the-dark is centered around the protein pigment in the retina known as visual purple. Since human eyes are seldom available for biochemical studies, most of the theories concerning the human visual pigment were based upon that of the frog, thought to be identical with that of the human being.

Recently the two scientists were able to obtain a human eye from a patient who had to have his eyes removed because of a cancerous growth. By special processing the pigment was separated from other portions of the retina and carefully analyzed photochemically. Evidence obtained indicated that the pigment is the chemical primarily concerned with the ability to see in the dark, as had been thought, but that it is somewhat different from the visual purple of the frog.

It is thought that this study may bring about changes in the theories of excitation of the visual sense cells (retinal rods), many of which were based upon data from the frog visual pigment.

Comet Has Heart of "Ices"

➤ THE COMET that showered "shooting stars" on us last August has a heart of "ices" of common gases.

Support for this theory was presented in the British scientific journal, *Nature*, by Dr. Peter M. Millman of the Dominion Observatory at Ottawa. He spotted hydrogen, lightest of all the elements, in photographs of the fanned-out light of visible meteor particles in August's Perseid meteor shower.

Dr. Fred L. Whipple of Harvard College Observatory has suggested that the solid nucleus of a comet, composed of ices of common gases, is turned by the sun's heat into the huge cloud of gas that makes up the comet's head. The fan-like tail, by which a comet is most easily spotted, is caused by the sun's radiation, which sweeps the gases and dust back from the head of the comet. Some of these hydrogen ices, Dr. Millman concludes, might well be retained in meteoritic particles large enough to produce a Perseid fireball in the visual magnitude range.

Dr. G. P. Kuiper of Yerkes Observatory has suggested that the hydrogen found by Dr. Millman could occur in the water of crystallization of certain chemical compounds believed to be present in the meteoric particles formed by comets.

Streptomycin Conquers Apple, Pear Disease

Plant Disease Controls

► CONQUEST of fireblight, a devastating disease of apple and pear trees, by using modern "wonder drugs" is forecast by experiments of Drs. H. F. Winter and H. C. Young at the Ohio Agricultural Experiment Station.

Streptomycin and terramycin, two of the antibiotics which helped revolutionize human medicine, have proved to be the first promising means of controlling fireblight.

Fireblight is caused by a bacterium *(Erwinia amylovara)* that usually enters a tree during the blossom season when bees transfer the bacteria from the flowers of diseased trees to blooms on healthy trees.

Drs. Winter and Young found that foliage sprays of streptomycin and terramycin made apple trees temporarily immune to bacterial infection. Applications of an antibiotic before and after a spray containing bacteria were found to control the blight.

Their results were striking. The spraying was done in the spring, and recently when the trees were examined they found that the trees given the antibiotic treatment are nearly blight-free while control trees, sprayed with bacteria but not with a drug, are heavily blighted.

Three applications of streptomycin gave almost 100% control of the disease, they report. Terramycin was slightly less effective.

An additional problem to be worked out is the high cost of the antibiotics. It is possible that a less refined form of the bacteria-killer may be made available for agricultural uses.

Fireblight wiped out the pear orchards of California 50 years ago and largely eliminated pears from Ohio. It also limits the production of many varieties of apples. Scientists have been investigating the disease for 75 years in hopes of finding a means of control. The antibiotics are the first to be found.

Antibiotics have also been found effective in fighting animal diseases and halo blight in beans. Farmers and fruit growers, however, have been cautioned on their use. In addition to killing the bacteria, the antibiotics also affect the plant hormones or auxins, stimulating some and retarding others.

Pests Destroy Trees

► INSECTS and diseases do more damage to America's timber resources each year than the fires that ravage millions of acres of land.

Ernest L. Kolbe, chairman of the U. S. Department of Agriculture Consultants on Forest Pest Control, and Lee M. Hutchins of the department's division of forest pathology, reported to the American Forestry Association Congress that diseases and insects destroy billions of board feet of timber each year.

They called for combined government and private research to combat

diseases and insects, and to work out forest management practices that will reduce the yearly losses.

This fourth Congress of the association was called to work out plans for cooperation between the federal government, the states and private timber owners to protect forest resources.

For Potato Virus X

➤ POTATO VIRUS X, a widespread mosaic disease that stunts plants and reduces yields, can be controlled chemically with malachite green, Dr. D. Norris of Australia's Commonwealth Scientific and Industrial Research Organization at Canberra has reported.

Laboratory tests show malachite green, a diaminotriphenylmethane dye, reduces the virus X content in potato plants to a very low level.

At the present time mosaic diseases are fought by developing resistant plant varieties and destroying insects that transmit the viruses. A successful means of attack with chemicals has been sought throughout the world.

The general problem of plant virus control has been handicapped by the lack of a demonstration that there is a sufficient difference between the chemical processes of the virus and the host to make selective chemical therapy possible, Dr. Norris stated in his report to the British Scientific journal, *Nature*.

In his tests, stems of potato plants were put in nutrient cultures where some were exposed to malachite green and the virus and others only to the virus. All plants of the untreated series had a high content of virus X, while in the treated series one plant was free of the virus and the others only had small amounts.

Pup Growth Sparked with Amino Acids

➤ PUPS will grow and be as frisky on a low-protein diet as with a higher protein ration, if you add a bit of two amino acids, raw materials for protein, to their meals.

A 12% protein diet, supplemented with lysine and methionine, led to normal dog growth equal to that on a 20% protein diet, found Drs. E. S. Robajdek and P. H. Phillips, of the University of Wisconsin's Agricultural Experiment Station.

Lysine alone with the low-protein diet allowed normal growth, but the addition of methionine made for more efficient use of the protein.

Two New Drug Discoveries a Year

➤ NEW DRUGS are being discovered at the rate of about two a year, or one every six months, Harry J. Loynd, president of Parke, Davis and Company, Detroit, declared at a recent meeting of the American Pharmaceutical Association. Only a few years back, he recalled, the drug industry and the medical profession felt much was being accomplished if one new drug was discovered every 25 years.

▶GERMANIUM *is being refined by the zone-melting process invented by W. G. Pfann, shown at the left. On the right, J. H. Scaff, who was closely associated with the development of the process, holds a large single crystal of germanium purified by this technique.*

Zone-Melting Refines Germanium

▶MELTED in moving sections by jumping through a hoop of hot wire, the wonder metal germanium rids itself of impurities as it goes.

The improved purification method, useful for the controlled blend of pure germanium with traces of other specific elements essential for transistor construction, was invented by W. G. Pfann of Bell Telephone Laboratories.

As an ingot of germanium passes through a hoop of induction heating

wire in this process a narrow band of the germanium melts and its impurities are dissolved in the liquid zone as it moves the length of the metal bar. Only one part in ten billion of anything but germanium remains, while other material becomes concentrated at the end of the bar. This end is then sawed off, leaving the pure germanium ready for final reworking into transistor material.

Transistor Hearing Aid Cost Low

➤ CHIEF present advantage of transistor hearing aids comes through lower operating costs, the American Medical Association finds.

Transistors are a recent development in the electronic field which are being used in hearing aids as substitutes for vacuum tubes. They may reduce operating costs by as much as 80% or more. This is because the transistor hearing aid needs only one battery and no heater current.

At present, the medical association reports, it seems that the size and weight of the hearing aid will not be changed appreciably. There does not seem to be any significant improvement in amplification, in tone quality, or in fidelity of the transistor hearing aid over other kinds.

The purchaser should insist on a written guarantee to cover possible mechanical and electrical defects in the instrument.

Jet Research Program Studies Ice

➤ ICE CAN cause complete jet engine failure in 60 seconds.

But jetliner passengers can take comfort in the fact that the aviation industry is aware of this peril and that it is seeking a way to "thaw out" the icing problem.

This past summer Avro Canada Ltd. sent chief test pilot Don Rogers into the sky with orders to fly through the same icing conditions that most pilots try to avoid. While doing so, he gathered valuable data on various deicing schemes designed for jets.

Although ice has been successfully combatted on piston-engined planes, the jet engine is highly vulnerable to it. Frequently ice forms around the intake, on the intake screens, on the stator blades and even on the spinning blades of the turbine's rotor. When this happens, air to the engine is partly choked off, reducing the power of the engine and increasing its internal temperature.

As the engine loses speed, the automatic fuel control system pumps more fuel into the suffocating fire, raising the temperature even higher.

Jet engine icing can be combatted chemically with an alcohol mist automatically sprayed into the engine intake when ice detectors flash their first warning. The entire air supply to the engine can be preheated, and sometimes removing the intake screen helps.

The plane's surfaces can be heated electrically or by hot gasses. Inflatable rubber "boots," used to crack built-up ice off piston-engined planes, generally were found unsatisfactory for jets because they could not stand the gaff of high-speed flight.

Chewing Tobacco Gets Blame For Cancer, Too

Cancer Factors Explored

➤ On top of reports blaming cigarette smoking as a cause of lung cancer comes an announcement that chewing tobacco and snuff have been found by one group of scientists to be associated with cancers of the mouth.

The announcement is made by the American Cancer Society. The finding is by Dr. George E. Moore, director of Roswell Park Memorial Institute, Buffalo, N.Y., and Drs. Lester L. Bissinger and Elsa C. Proehl of the University of Minnesota Medical School, Minneapolis.

All men over 50 who registered at the University of Minnesota Hospital Tumor Clinic since 1951 and who had chewed tobacco 20 or more years were interviewed about their tobacco habits. The area served by the hospital has a large population of snuff and tobacco chewers.

The studies showed that mouth cancers usually developed only after fifteen years or more of continuous exposure of the mouth lining. Many who had chewed tobacco less than this time had developed mouth sores and tissue changes (thickening and leukoplakia) which the scientists felt might become cancerous unless the tobacco users discontinued their habit. A high percentage of those with mouth cancer reported that they had developed sores early in their habituation at the site where they held their quid. This observation was interpreted as suggesting that perhaps these patients were unusually sensitive or allergic to tobacco.

Twenty-six of 40 men with mouth cancers were long-term tobacco or snuff chewers. Similarly, 18 of 23 patients with mouth leukoplakia, a condition which some clinicians consider pre-cancerous, were tobacco chewers.

Fewer patients in the same age group who had various benign diseases or cancers not associated with the mouth used chewing tobacco.

Cigarette, cigar and pipe smoking were not significantly associated with the development of mouth cancer. This study did not include lip cancer or cancer of the lung.

The scientists are now testing the ability of tobacco quids to produce cancers in the pouch of hamsters. The food pouches of these animals are lined with tissue similar to that of the mouth and are readily used to hold experimental quids.

Cancer Rare in Monkeys

➤ Cancer research is handicapped by the rarity of cancer in monkeys naturally and the inability of scientists to produce cancers in the animals artificially.

Dr. Paul Steiner, pathologist on leave from the University of Chicago at the National Cancer Institute, Washington, D.C., pointed out that scientists have no experimental and transplantable primate tumors to study.

Monkeys, like man, are primate mammals. Most cancer research involving animals is now done with rats and mice.

Efforts by Dr. Harold L. Stewart, chief of the pathology laboratory at the Institute, to induce cancers in monkeys with powerful hydrocarbons, which in other animals are known cancer-causing compounds, or carcinogens, have so far failed.

Both pathologists pointed out that studies of monkeys have not included many old animals. The incidence of cancer is usually much greater in old animals than in younger, and the rarity in monkeys may be due to insufficient observation.

Reports from zoo autopsies, however, indicate that tumors and cancers have been rare in those monkeys that have lived and died in captivity.

Dr. Steiner reported that some individuals in a monkey colony at the University of Chicago developed cancer of the tongue and mouth. No other monkeys in the colony, though, have had cancers since that time.

The scientists could offer no explanation for the apparent resistance of monkeys to cancer.

It is known that different species of animals and different individuals vary greatly in their susceptibility to natural and induced cancers. Some of this resistance may be environmental and some may be tied up with heredity.

Dr. Steiner said that experiments with monkeys and cancer have been inconclusive. The great expense involved in experimenting with such animals has held back research.

In-bred strains of mice have been developed in which the incidence of cancer can be predicted with great accuracy. These animals have been of great use in the study of cancer. They are, however, much lower in the evolutionary scale than primates.

The National Cancer Institute is one of the National Institutes of Health of the U. S. Public Health Service.

Liver Factor in Cancer

➤ SOME GROWTH factor produced by the liver as it regenerates can speed the growth of cancer, Drs. Karl E. Paschkis, Abraham Cantarow and J. Stasney of Jefferson Medical College, Philadelphia, have discovered. Their finding was announced by the American Cancer Society, which supports their work.

Scientists elsewhere have offered the emaciation of cancer patients and other evidence as proof of a hypothesis that as cancer grows it draws its protein materials from the body's normal tissues.

The Jefferson team tested this theory by removing two-thirds of the livers of rats when they transplanted cancers to the animals. If the theory were correct, the liver might repair itself more slowly than usual.

The livers of the animals, after about 48 hours of quiescence, began growing with a great spurt, and they regenerated completely at the normal rate. But this did not slow down the growth of the cancer.

In two kinds of cancer, one of the liver and another of the connective tissue, cancer growth was more rapid than ever.

Gold-Fattened Mice

➤ DISCOVERY that mice fattened by injections of gold are at least twice as

likely to get cancer as normal mice is announced by Dr. Samuel H. Waxler and Pelagio Tabar of Stanford University.

Apparently it is the fat and not the gold chemical that caused the increase in rate of cancer development, since a few mice did not get fat in spite of the treatment and among these the frequency of cancer also dropped.

Dr. Waxler plans to use gold-fattened mice for a study of the effect of overweight on heart disease.

The injections of gold thioglucose, Dr. Waxler had found previously, gives the mice a ravenous appetite and causes them to develop thick layers of fat. They gain two or three times their normal weight.

Among gold-fattened mice, 64% of males between the ages of one year and 16 months developed cancer of the liver, compared to 28% of control mice. These were all from a cancer susceptible strain in which about 25% unfailingly develop cancer.

Among female gold-fattened mice, 50% developed breast cancer by the age of 295 days, compared to 19% of normal weight females.

Atomic Reactor Waste
To Sterilize Food

Radioactive Wastes Set in Concrete

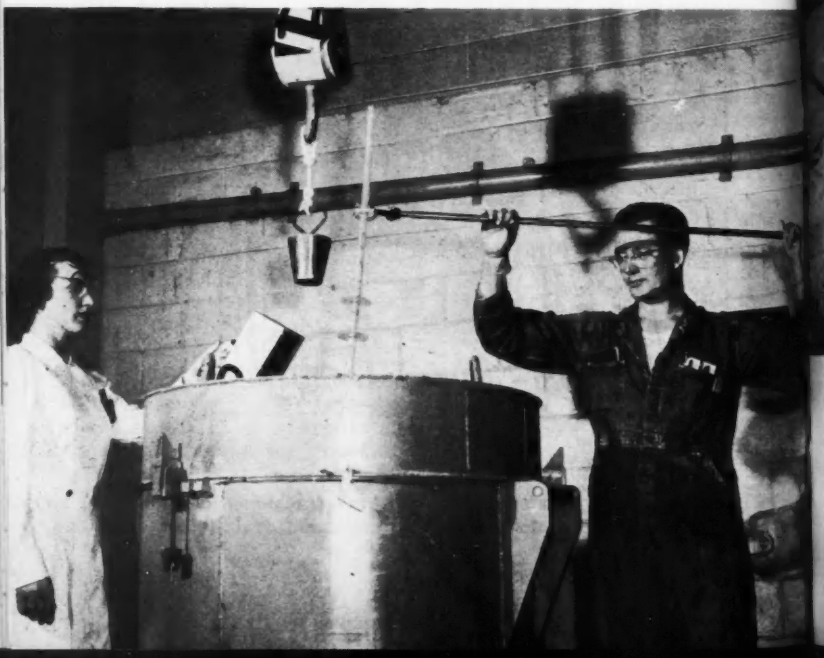
➤ A BY-PRODUCT of atom-bomb manufacture some day may sterilize cans of pork and beans and whole kernel corn before they are shipped to your grocer.

Scientists at the Massachusetts Institute of Technology are planning experiments with nuclear reactor waste products. They want to harness this A-bomb offshoot to commercial food sterilization.

Prof. Bernard E. Proctor, head of MIT's department of food technology, said the atomic waste presumably would be inexpensive. It is a mixture of fission products obtained during the manufacture of plutonium. No price as yet has been set for it.

Currently these radioactive waste products must be stored in tanks. They cannot be simply dumped out because they might pollute drinking water, or otherwise endanger human life. But if a commercial food-sterilization process can be devised, the disposal problem should be minimized.

➤ RADIOACTIVE *concrete, which holds fission products in a form in which their radioactivity can be made useful, is being calibrated at Argonne National Laboratory.*



▶ APPARATUS *in which radioactive concrete containing fission products is mixed. The cavity in the center provides a pocket into which materials can be put to be irradiated.*

Sponsored by the Atomic Energy Commission, Prof. Proctor and his assistant, Dr. Samuel A. Goldblith, assistant professor of food technology, will measure the strength of the food-sterilizing gamma rays produced

by the atomic waste. They will study the effect these rays have on various foods, and they will learn how long the source will remain potent.

The source itself already has been shipped to MIT from the AEC's Argonne National Laboratories in Chicago. It is a radioactive liquid which has been mixed into the cement walls of a small hollow cylindrical block. Its strength equals several pounds of uranium.

The cylindrical cement block is surrounded by several inches of ordinary concrete. A thick lead lining also helps to prevent the deadly X-rays from injuring persons who work around the unit.

An opening into the center of the unit permits foods to be lowered into the "hot" radioactive region for sterilization.

Although the new radioactive source is not as powerful as a previously studied cobalt source, it is "the material which we will actually have for commercial purposes," Dr. Goldblith said, "so we must learn how to use it."

Radioactive cobalt is not available in large enough quantities to meet commercial demands.

Rare Earth Elements Separated

➤ NEW PRACTICAL ways of separating rare earth elements from the minerals in which they occur were reported to the American Institute of Chemical Engineers recently by Drs. F. H. Spedding and J. E. Powell of Iowa State College, Ames, Iowa.

Rare earths are becoming industrially important, especially in atomic engineering.

The method involves ion exchange or replacing one element with another in order to get the desired element in a more pure or separated form.

A pilot plant showed that out of a crude rare earth concentrate from the mineral gadolinite, the rare earths erbium, ytterbium, dysprosium, yttrium, thulium, and holmium were obtained 99.9% pure. The cost of the chemicals and water used in the process is low despite the large volumes required.

In another process reported by Dr. Spedding with J. Bochinski and M. Smutz, rare earths were separated from each other by extracting solution of their nitrates in water with undiluted tributyl phosphate.

Why Metals Make Good Bearings

➤ WHY a bearing runs smoothly without "freezing" or welding to the journal that revolves in it has been puzzled out scientifically by a research team at the General Motors Research Laboratories in Detroit.

It is a matter of how much iron of the revolving shaft is dissolved in the bearing metal at its melting point which is reached at the bearing surface when the bearing heats up. Those metals with extremely limited or negligible solubilities in iron, such as lead, tin, indium, thallium and cadmium, have good score resistance, as resistance to such welding is called.

For The Home Lab

Lead

by Burton L. Hawk

➤ This month we have a heavy subject to discuss: lead.

Lead was probably known during the prehistoric age. References to it are found in the Old Testament.

The Babylonians used it for engraving and later the Romans used it for water pipes and coins.

Although not plentiful, lead is widely distributed in nature. It occurs chiefly as the sulfide, PbS, known as *galena*. This ore is roasted to obtain the monoxide, PbO, which is in turn roasted with carbon to obtain the metal.

The low melting point and chemical inactivity of lead make it useful for many purposes. You are familiar with it as waste pipe for plumbing fixtures. It is used in constructing apparatus for the manufacture and handling of sulfuric acid. And, of course, it is mighty important in the manufacture of storage batteries. Also, it is used in many important alloys, such as solder, type metal, pewter, Babbitt metal, and shot.

Metallic Lead

Cut a piece of lead and note that the surface is brightly lustrous at first. However it is soon covered with a dull gray coating containing the monoxide, basic carbonate and lead particles.

You can prepare lead in the laboratory by the reduction of the oxide, PbO, with carbon. Mix together one portion of lead monoxide with two portions of powdered charcoal. Place in a crucible, cover, and heat strongly for about 15 minutes. Allow to cool, and dump the powder out. If you examine it closely, you will find small balls of pure lead. If you wish, you can collect the balls and fuse them into one solid piece.

Lead Monoxide

Heat a piece of lead in a shallow metal pan or evaporating dish. It melts at 327.5 degrees. The molten metal is soon covered with a light yellow scum. This is lead monoxide, PbO. It can also be obtained by carefully heating lead nitrate crystals.

Lead monoxide is a yellow powder known as *massicot* and commercially as *litharge*. When mixed with glycerine it forms a quick-hardening cement used by plumbers. It is also used in lead glass, varnishes, for glazing pottery and as a pigment for rubber.

Red Lead

If you will heat lead monoxide strongly (to 500 degrees) in the air, it will gradually turn red in color as red lead oxide, Pb_3O_4, is formed. Actually red lead is not an oxide itself, but a mixture of two lead oxides, PbO and PbO_2. If you want to be technical about it, it could be called *plumbous plumbate*, Pb_2PbO_4.

It is used as a rust-protective paint for iron or steel, in cements, varnishes, matches, etc.

Lead Dioxide

Add a small quantity of red lead to dilute nitric acid in a test tube. Immediately a brown precipitate of lead dioxide is obtained.

It is a vigorous oxidizing agent and is used as such in the manufacture of dyes. It is also used as electrodes in batteries, in rubber substitutes and with amorphous phosphorus as the ignition surface for safety matches.

White Lead

White lead has been widely used for years in paints. It is the basic carbonate, $Pb(OH_2)_2 \cdot 2\,PbCO_3$.

Add a solution of sodium carbonate to a solution of lead nitrate to obtain the snow-white precipitate. Now add a few drops of sodium sulfide, or bubble hydrogen sulfide gas through the mixture. The white precipitate turns black, which indicates that white lead paint should not be used where it will be exposed to sulfide vapors.

Lead Chloride

Lead chloride is soluble in hot water but not in cold. Prepare a dilute solution of lead nitrate in a test tube and add a few drops of hydrochloric acid. The heavy white precipitate of lead chloride is formed and settles quickly to the bottom of the tube. Heat the solution to boiling and continue to boil until the compound is entirely dissolved. If necessary, add more water. Then place the tube in a container of cold water. Soon you will see the lead chloride crystallize in sparkling flakes which will fall rapidly through the solution, not unlike a miniature snowstorm.

Other Compounds

When you add a solution of potassium dichromate to a solution of lead nitrate, a bright yellow precipitate is formed. This compound, lead chromate, is known as *chrome yellow* and is used as a yellow paint pigment.

Lead iodide is also bright yellow in color. Prepare it by adding potassium iodide solution to the lead nitrate.

Lead monoxide dissolves in acetic acid to form lead acetate, $Pb(C_2H_3O_2)_2$. This compound is also known as *sugar of lead*. It is used in various ointments, in dyeing and printing cottons.

When sodium hydroxide is added to lead nitrate, lead hydroxide, $Pb(OH)_2$, is obtained. If this hydroxide is dissolved in acids, *plumbous* salts such as plumbous chloride, $PbCl_2$, are formed. If it is dissolved in bases, *plumbites*, such as sodium plumbite, Na_2PbO_2, are formed.

When lead dioxide is dissolved in concentrated sodium hydroxide, sodium *plumbate*, Na_2PbO_3, is obtained.

Lead tetraethyl, $Pb(C_2H_5)_4$, used for "ethyl" gasoline, is made by treating sodium and lead alloy with ethyl bromide.

As lead salts are poisonous, be sure to wash your hands thoroughly after experimenting.

Chemical weed-killers were applied to some 30,000,000 acres of crops in America last year.

Sensitive instruments that will detect extremely small quantities of poisonous gas in the air are being used in highway tunnels to protect motorists from danger.

Recipes to Aid Rash Bettors

Wardrobe Cookery

Reprinted from *Newsweek*

➤ IN THE RECENT Canadian national elections, a Toronto Star reporter bet that he would eat his shirt if his candidate lost. Forced to pay off, the newspaperman appealed for advice to the National Research Council of Canada. The recipe he received was published in the journal *Chemical and Engineering News*.

"Take one cotton shirt and burn to a crisp in a very hot oven and recover hot ashes. Then grill one large steak, sprinkle shirt ashes on steak, and smother with onions. Eat shirt, steak, and all."

As a service to men and women who lose similar rash wagers on the upcoming elections in the U.S., *Newsweek* has consulted leading American chemists and presents the following recipes designed to make almost any item of wearing apparel edible and digestible if not downright delicious.

Shirts, dresses, socks, underwear, etc., made of cotton or rayon: Whereas it is simplest to reduce such clothes to ashes (see above), the gourmet prefers to convert them to pancake syrup. This is done by immersing the cloth in a weak acid solution and boiling in a pressure cooker, which breaks down the cellulose and starch into simple sugar molecules. The resulting sugar is not identical with cane sugar, but it is sweet and safe to eat.

To neutralize the acid, add bicarbonate of soda slowly until fizzing stops.

Buttons offer no problem. Some are made of plastic and will char in a hot oven. Those carved from vegetable ivory (source: palm nuts) change to a kind of sugar (mannose) when boiled in acid. Real mother of pearl is best ground and swallowed, or pulverized and used as tooth powder. It is an excellent source of calcium in the diet.

Hats, shoes, silk dresses, and woolen suits: These are protein and, like cotton, can be hydrolyzed by boiling in acid. The end product is a gluey gravy of amino acids which, as one chemist notes, "tastes like hell." Nevertheless, the amino acids are as nutritious as the whole protein. The same result can be obtained by soaking the apparel in a digestive enzyme (pepsin or trypsin). By either process, the gravy is similar to the contents of the human stomach soon after a meal of meat or cheese.

Nylon, Dacron, Orlon, and other synthetic fabrics: When dealing with these materials, the layman had better not fool with hydrolysis. The end-products might be toxic. They are better burned or thoroughly charred until nothing remains but carbon ashes.

The chemical advisory board offered a word of caution. Some people might be allergic to dyes. If you must eat your shirt, eat a white one.

Glands Stimulated By Amino Acids

Cortisone Applications Extended

➤ DISCOVERY that some of the body's glands, such as those that produce anti-arthritis cortisone and ACTH, may be stimulated by the amino acids that build high quality protein food is announced by two Finnish doctors in a report to the Endocrine Society.

The physicians making the report are Drs. Ilmari Vartiainen and Juhani Apajalahti of the University of Helsinki.

Diets that do not come up to the best in quantity of such foods could, therefore, lead to diseases of the endocrine glands and of body metabolic processes, the doctors point out.

Their findings were made in tests of the number of white blood cells of the kind called eosinophils following feedings of proteins, such as gelatin and the milk-cheese protein, casein, and of tyrosine, one of the essential amino acids found in casein but not in gelatin.

When healthy volunteers swallowed test meals of casein and tyrosine, the number of eosinophils circulating in their blood dropped. The effect was much weaker when the test meal consisted of gelatin.

American scientists have already shown that the number of eosinophils in the blood is decreased by ACTH from the pituitary gland. Presumably this is because ACTH increases the production of adrenal gland hormones such as anti-arthritis cortisone.

Epinephrine, or adrenalin, another adrenal gland hormone, causes a similar decrease in eosinophil cells. The theory is that epinephrine produces this effect by a circuitous path through which it stimulates the pituitary to produce more ACTH.

A German scientist had suggested that proteins in foods might produce changes similar to those caused by epinephrine and that proteins could be considered as stimulants to the sympathetic nervous system. The Finnish doctors decided to test this theory. The results are reported in the Endocrine Society's official publication, the *Journal of Clinical Endocrinology and Metabolism*.

Cortisone in Spinal Fluid

➤ CORTISONE, adrenal gland hormone famous as a remedy for arthritis and other diseases, normally gets into the spinal fluid, it appears from tests made by Drs. D. N. Baron and Denis Abelson at Middlesex Hospital Medical School, in London. Dr. Abelson is now at Yale University School of Medicine, New Haven, Conn., U.S.A.

The spinal fluids they examined came from patients having spinal punctures done and fluid removed in the course of neurological examinations. Paper chromatographic methods were used to detect the presence of cortisone and hydrocortisone.

The provisional identification of cortisone in spinal fluid is important, the scientists point out, because some workers have failed to find these hormones in normal blood plasma.

Details of the tests are reported in the scientific journal, *Nature*.

Speeds Paralysis Recovery

➤ CORTISONE shows promise of becoming a speedy remedy for Bell's palsy, also known as facial paralysis.

Two children afflicted with this ailment recovered completely in 13 and 17 days, respectively, under cortisone treatment, Drs. W. P. Robison and B. F. Moss of the Medical College of Georgia, Augusta, Ga., report in the *Journal of the American Medical Association*.

In their experience no patient seen in 15 years has recovered from this paralysis in less than several months. The Augusta doctors point out that results in two cases do not warrant sweeping conclusions but they call attention to an earlier report of Dr. H. H. Rothendler of New York who treated six Bell's palsy patients successfully with cortisone.

The treatment apparently must be started early in the course of the paralysis, since a seventh patient of Dr. Rothendler's who had had paralysis for 10 days before cortisone was started did not respond to the treatment. Tests before the cortisone was started had showed signs of nerve destruction in this patient.

The cause of Bell's palsy is not known. It is a common disorder that may attack from infancy to old age. Dr. Rothendler reported that he thought cortisone helped by reducing congestion and related local deficiency of blood of the facial nerve and its sheath in the bony canal.

ACTH Saves Lives

➤ ACTH, pituitary gland hormone, has saved lives of patients threatened by a rare but almost always fatal complication following major operations, Drs. John V. Prohaska, Michael C. Govostis and Matthew Taubenhaus of Chicago report in the *Journal of the American Medical Association*.

The complication is a colon inflammation known as pseudomembranous enterocolitis. It is characterized by fever, increase in white blood cells, diarrhea, weakness, lethargy, abdominal pain, tenderness, gaseous distention and paralytic ileus.

The real cause of the condition is not known. The fact that it occurs rarely makes it difficult to diagnose. Heretofore there has been no known treatment.

The Chicago doctors report immediate, complete and in one case "spectacular" recovery of three gravely ill patients treated with ACTH. In contrast, four other patients, who suffered the same complication but did not get ACTH, died. It was after seeing these patients die that the doctors decided to try ACTH.

Why this hormone is effective in this condition is not known. The doctors are exploring the possibility that the disease is one of tissue necrosis resulting from antigen-antibody reaction.

They warn that intestinal inflammation due to bacteria should be ruled out before ACTH is given, because any bacterial disease would be markedly aggravated by the hormone.

New Synthesis

➤ THE CHEMICAL that gives the sting to ants and nettles plays a key role in a new method of synthesizing the latest anti-arthritis hormone, hydrocortisone, or compound F.

Announcement of the new synthesis

as affording a potentially cheap and plentiful supply of the drug was made by Dr. Eugene P. Oliveto, Miss Corinne Gerold and Dr E. B. Hershberg of the Schering Corporation, Bloomfield, N. J., at the meeting of the American Chemical Society's North Jersey section.

The ant and nettle sting chemical, formic acid, is used in the new process to yield a formate of the steroid compound which is obtained from ox bile or, more recently, from fermentation processes. This formate goes through later steps in the synthesis of hydrocortisone without destruction of the complicated molecular structure which makes the compound active.

Arthritics Make Wrong Hormone

➤ Discovery of a body chemical that develops in patients with arthritis was announced by Dr. C. P. Rhoads, director of Sloan-Kettering Institute for Cancer Research, New York, at a recent meeting of the Association of American Physicians.

The chemical is an "abnormal hormone" produced by the adrenal glands which also produce cortisone, famous for the relief it gives to arthritis patients. The abnormal compound is called 17a-hydroxypregnanolone.

This abnormal hormone was found in the urine of seven arthritis patients but not in the urine of 29 normal persons. With production of this hormone goes decreased production of normal hormones such as cortisone. Giving cortisone causes a drop in the amount of the abnormal hormone.

The discovery was made in research by the late Dr. Konrad Dobriner and Drs. T. H. Kritchevsky, Attallah Kappas and T. P. Gallagher, all of Sloan-Kettering Institute.

Algae May Provide Oxygen

➤ Algae, like the green scum on ponds, will provide oxygen for space explorers living at high altitudes above the earth if studies underway at the University of Texas prove practical.

This was forecast by a report to the American Institute of Biological Sciences by Dr. Jack E. Myers and Dr. J. Neal Phillips, Jr., who have found ways to increase the growth of algae in sunlight. These little aquatic plants use light energy more efficiently to store energy in mass growth and oxygen production if exposed to alternate periods of light and dark. The Texas scientists stir the growing mass of algate culture and high turbulence gives the desired light fluctuations. Overcrowding of the algae is prevented by automatic methods of diluting the culture as the many billions of cells become too crowded.

Progress achieved has caused the Department of Space Medicine of the U. S. Air Force School of Aviation Medicine to support research for future use.

Heavenly Meteor Dust Makes Rain on Earth

Rainmaking Meteor Dust

➤ METEORITIC dust sifting down from the heavens may do more to "make" rain than all the particles human rain makers throw into clouds as "seed."

This is shown by research by Dr. E. G. Bowen, director of the radiophysics laboratory of the Commonwealth Scientific and Industrial Research Organization, Sydney, Australia.

Dr. Bowen's studies show that, 29 or 30 days after the earth enters a major meteor stream, if rain falls at all, the chances are extremely good that the rainfall will be a heavy one. He pointed out that the chances of rain occurring on a certain day are not due to meteoritic dust, but are determined by local and world-wide weather patterns.

However, if, about a month after a big meteoritic shower, these weather patterns are such that rain does fall, then the amount of rain will be considerably increased because of the meteoritic dust in the atmosphere.

His new findings are expected to influence artificial rainmaking, now a most controversial weather subject. Western ranchers and farmers spend hundreds of thousands of dollars a year on efforts to make it rain, yet the Weather Bureau, backed by nearly a 100 years of records, often can tell them it would have rained without the rain maker's efforts.

President Eisenhower recently appointed a Committee on Weather Control and Evaluation, headed by retired Navy Capt. Howard T. Orville of the Bendix Aviation Corp., Baltimore, to check on the success or failure of cloud seeding experiments and to recommend weather control laws.

Dr. Bowen hit upon the meteoritic dust effect when he discovered that heavy rainfalls occurred on certain days rather than on others, and that this pattern was repeated "year after year." Later, he found the heavy rainfall peaks occurred on nearly the same days in both the northern and southern hemispheres.

The reasons for this world-wide, repeating pattern, Dr. Bowen concluded, would most likely be from outside the earth. That meteor showers were the answer was clinched when he discovered that the times of rainfall peaks varied by one day prior to 1900. Because of the way our calendar is set up, days of peak rainfall observed prior to 1900, by actual date, would come one day earlier than those found during this century.

Dr. Bowen's conclusion is that meteoritic dust exists in adequate quantities to affect the rainfall of the lower atmosphere, and its time of fall is of the right order to account for the observed interval between meteor showers and peaks of rainfall.

Other scientists have found that the total mass of material falling on the earth in sizes large enough to give visible meteors is about a ton a day. This visible material is accompanied by dust, and the amount of these dust particles swept up by the earth in its

path is thought to be about 10,000 tons a day, on the average.

It is this dust accompanying meteor showers that provides the rain-forming nuclei, Dr. Bowen believes, when it falls into cloud systems in the lower atmosphere. When they are in interplanetary space, the particles are believed to have speeds of six to eight miles an hour in relation to the earth.

However, on entering the earth's atmosphere, those particles less than two ten-thousandths of an inch in diameter are stopped sharply at a height of about 60 miles. It would take particles of this size from 30 to 50 days, Dr. Bowen has calculated, to drift from 60 miles to 40,000 or 50,000 feet, the height at which most towering clouds are found.

Among other effects that sudden stopping of the meteoritic dust might produce on our atmosphere, Dr. Bowen states, are the noctilucent, or night-shining, clouds high in our atmosphere. Nearly 20 years ago, Dr. E. H. Vestine of the Carnegie Institution of Washington, charted the dates of the appearance of these noctilucent clouds, and some of them coincided then with the then known meteor streams. New daytime meteor showers, discovered by use of radar 15 or more years later, also correspond to the dates on which Dr. Vestine found night-shining clouds appeared.

Throwing silver iodide at clouds from ground generators does not cause a single raindrop to fall, it appears from recent Australian experiments described by Dr. Bowen, during which the number of rainforming particles in the air were counted under various weather and wind conditions.

These experiments have added to the controversy over whether rain can be caused artificially by seeding clouds with silver iodide particles, now a multi-million dollar a year industry.

Silver iodide particles, the studies have shown, cannot be detected higher than 2,000 feet nor farther downwind than 10 or 12 miles from the generator. They also lose their activity at an extremely rapid rate in free air.

Weathermen attending the American Meteorological Society meeting in New York recently learned of the Australian experiments from Dr. Bowen. The number of rain-forming nuclei, either silver iodide or other particles, found downwind from a silver iodide generator were measured by taking air samples at various heights and distances from the generator, then putting the samples in a super-cooled "cloud" in the laboratory and counting the number of drops formed. The number of rain-forming nuclei dropped to the number normally found in air, which is about one per quart, 10 to 12 miles downwind and 2,000 feet up from the generator.

The loss of activity, or decay rate, of the silver iodide was measured by throwing out a mixture of zinc sulfide, which does not decay with time, and silver iodide, then catching samples of air as before. Silver iodide, these studies showed, loses its activity by a factor of 10,000 times within 30 minutes.

Dr. Ben K. Seely of the New Mexico Institute of Mining and Technology helped to direct and perform the decay rate studies. Drs. F. J. Smith and A. J. Heffernon of the Radiophysics Laboratory in Sydney, Australia, conducted the experiments on the diffusion of silver iodide particles.

Hormones, Drugs Control Plants

Clues to Plant Chemistry

▶ THE DAY is not far off when florists and gardeners can make plants bloom at will by injecting them with a synthetic flowering hormone.

So predicts Dr. Karl Hamner, professor of botany at the University of California at Los Angeles.

Dr. Hamner and others for many years have been on the trail of the elusive flowering stimulus, which appears to be a new plant hormone. Although the substance has not been definitely isolated, so many new facts have been learned about it in recent years that it seems possible that it will be identified soon, he thinks.

"Once the hormone is identified, we should be able to produce it synthetically and apply it to plants to induce flowering," he adds.

Scientists have known for some time of a clock-like mechanism in leaves which aids plants in regulating the manufacturing of the flowering hormone according to the length of day. Some plants flower in the middle of summer because days are longer, while others flower in late summer or fall because days are shorter.

More recently Dr. Hamner has determined the rate at which the hormone moves through the stem to the buds and the manner in which it may be diverted or destroyed after it has been manufactured and before it reaches the bud. This information has practical implications as it is desirable at times to prevent flowering.

Plant Breeding Short-Cut

▶ NEW PLANTS will be produced years earlier than previously possible by use of a powerful drug that fixes a desired characteristic for heredity, Dr. J. G. Ross and C. J. Franzke of the South Dakota Agricultural Experiment Station predicted at the American Society of Agronomy meeting in Dallas, Texas.

Colchicine has been found to stabilize the characteristics of a new strain of sorghum seedlings in a single year so that the characteristics are transmitted to succeeding generations. Treatment of sorghum seedlings with colchicine produced a wide variability in the plants, the agronomists said. The treatment then fixed a chosen characteristic for transmission to later generations.

In the past, plant breeders have often spent many years developing a plant strain with certain desired characteristics. Frequently the seed of such plants is sterile or the characteristics are not transmitted to succeeding generations.

An examination of four generations of the sorghum seedlings in their experiments showed that under controlled conditions the desired changes in the plant were immediately and permanently established in the new varieties.

Different Virus Strains

▶ HERE'S a problem that has long puzzled virologists, those scientists who work with viruses:

Why is it that certain strains of a virus cause a more severe form of disease than other strains?

Dr. William Ginoza and Dr. S. G. Wildman of the botany department and Dr. D. E. Atkinson of the chemistry department of the University of California at Los Angeles have found a clue to this mystery.

In studies of two strains of a virus that cause a disease among tobacco plants known as tobacco mosaic, it was found that the strain which causes a more severe form of the disease has an affinity for certain nucleoproteins of host cells.

The severe strain, when removed from plant cells and purified by chemical processes, appeared amber in color. The mild strain was colorless. The severe strain could be decolorized but regained its color when mixed with juice from an uninfected leaf. The mild strain remained colorless in all cases. The color resulted from an affinity or a combining of the virus with nucleoproteins of the tobacco plant cells.

This affinity may be due to certain surface configurations of the virus into which host cell proteins fit like pieces of a jigsaw puzzle. The severe symptoms caused by the colored strain may arise because this strain binds and makes inactive a protein required for the normal metabolism of the host, the investigators suggest.

Protein-Rich Food Out of Cottonseed

➤ THE LOWLY, but protein-rich cottonseed may one day make the grade as a main course at the dinner table, that is, if meat's hard to get.

Tasty recipes using cottonseed as a main ingredient are the result of work at the Chemurgic Research Laboratory of Texas A. and M. College, Dr. W. W. Meinke reports from there. Ground to a meal and then fermented with parched wheat, cottonseed turns into a meat-flavored sauce. Passed through a salt-solution process and mixed with lactic acid, the seeds yield a cheese-like whey. Roasted like nuts, the kernels become the chief ingredient in cottonseed candy.

Cottonseed is high in protein. With the nation's population increasing and its land reserves decreasing, the use of all plant protein sources becomes highly desirable. Only 40% to 50% of the available protein in plant life is converted in meat consumption. On the other hand, the direct release of plant proteins retains from 80% to 90% of the available protein for the nation's food supply.

Cottonseed oil has long been used in the manufacture of oleomargarine and shortenings, and small amounts of cottonseed flour are used in bread, cookies and cakes. But use of cottonseed as an edible product was always restricted to small amounts because it contains a toxic ingredient called gossypol. Also, the cottonseed meats were affected by a purple discoloration. Now, however, Dr. Meinke's research has developed methods by which to make the cottonseed thoroughly fit for large-scale consumption.

The final tests of the cottonseed products, of course, will be made only when the public has had a sample of them for judgment.

Oranges, Hot Dogs, Lips And Candy May Grow Pale

Food Colors Reviewed

by JANE STAFFORD

➤ CHILDREN sick after eating too much Hallowe'en candy, oranges which consumers refuse as less tasty because their color is not orange, milady's cheeks and lips decorated with less pleasing hues, pale hot dogs, and a million dollars a year in dyes alone. These are some of the problems involved in hearings begun by the U. S. Food and Drug Administration.

The hearings concern proposals to ban the use in foods and perhaps also in drugs and cosmetics of three coal-tar colors, or dyes, known as FD&C Red No. 32, FD&C Orange No. 1 and FD&C Orange No. 2. (The FD&C stands for Food, Drug and Cosmetic and refers to the FD&C Act of 1938.)

Chemically, these dyes are: 1-Xylylazo-2-naphthol; Monosodium salt of 4-p-sulfophenylazo-1-naphthol; and 1-o-Tolylazo-2-naphthol.

The second one in the list, FD&C Orange No. 1, was one of the first water-soluble azo dyes manufactured and was in common use in foods in the United States as far back as 1907. The other two have obscure histories, but were in use long before 1938. When the first so-called pure food law was passed almost half a century ago, these, among other colors, had been used in foods for many years and these three were certified for use in foods under that old law.

At that time, the safety of dyes in foods could not be tested with the accuracy possible today. In 1938, the new law made illegal the use in foods of any coal tar dye not certified. So the then new Food and Drug Administration, set up to administer the law, listed those dyes that had already been certified.

But since then a number of things have been worrying FDA officials. One is that the law says if a substance is poisonous, it cannot be used in food even if the amount used is so small it will not harm the consumer. Because of that and because new tests had been developed, FDA had a series of colors tested. The results show that FD&C Red No. 32, FD&C Orange No. 1 and FD&C Orange No. 2 are not harmless, although in the quantity used in food, there has been no evidence of any injury to humans.

There was, however, that episode of some children getting stomach and intestinal upsets from Hallowe'en candy. The candy, it turned out, was colored with a tremendously larger than usual amount of one of the colors. And the children's sickness was nothing like that seen in the laboratory animals given large doses of this same color.

Chief use for one of the three colors is in Florida oranges. Some of the orange producers are said to be in favor of banning the color, while others want to be allowed to go on using it. Casings for sausages take a lot of another of the colors. Cheese, cough drops and other drugs, as well as candies, cakes and cosmetics use the three colors.

News of Several Elements Which Have Found New Uses

Elements in New Combinations

Silicon Transistor

➤ A MUCH sought after silicon transistor at last has been made in the laboratory. It should solve a pressing heat problem now plaguing designers of airborne military electronic gear. Only a few ten-thousandths of an inch thick, the little wafer can do many jobs of conventional vaccum tubes in radio and television sets, hearing aids and electronic "brains."

Although the transistor in many ways is an answer to the dreams of electronic engineers, the silicon model will not go into commercial production until improvements can be made in the refinement of silicon, David B. Smith, Philco's vice-president of research, told the Institute of Radio Engineers.

Previous transistors largely have been made of germanium. This rare metal comes with a price tag of about $500 a pound.

Found in common sand, silicon is one of the earth's most plentiful materials. It not only costs less than germanium but also withstands rugged temperatures that "knock out" germanium's transistor qualities.

Using two jets of an indium salt, Philco engineers etched a thin wafer-like slab of silicon to microscopic thickness. At the desired point, the electric current passing through the silicon and liquid jets was reversed. This instantly electroplated the silicon with indium. Then electrodes were attached to the silicon wafer.

The resulting silicon transistor kept its desirable properties at high temperatures. It also worked well in the high-frequency radio band.

Transistors are becoming increasingly important in the field of electronics. This is particularly true of airborne gear such as radar and radio. Transistors, because of their tiny dimensions, permit the gear to be made lighter, and to be squeezed into smaller spaces on today's more complicated jet bombers and supersonic fighters.

But transistors cannot do all the jobs of vacuum tubes. Consequently they often must be mixed with conventional tubes.

It is not practical to do this in airborne equipment today because heat given off by the tubes cannot escape easily. Highly sensitive to heat, germanium transistors are unreliable under those conditions. Engineers, however, believe the silicon transistor is the answer to this problem.

Hafnium Stands Heating

➤ DON'T WORRY about the amount of hafnium in your zirconium.

Tests on pure isotopes of these twin elements at Oak Ridge, Tenn., show that heat-resisting ceramics made of pure hafnium can take 1,700 degrees Centigrade without cracking up, while similar products made from pure zirconium go to pieces at about 1,000 degrees. Zirconium is the metal ob-

tained from zircon, sparkling substitute for diamonds.

Wanted for the framework of nuclear reactors, zirconium is being studied for heat resistance by the ceramics department of Oak Ridge National Laboratory, operated by Union Carbide and Carbon Corporation for the Atomic Energy Commission. Hafnium is a naturally occurring twin element whose compounds are so much like those of zirconium that their separation is almost impossible.

The question whether hafnium is harmful in the mixture has been answered by the new knowledge gained from the pure isotopes. Hafnium is not harmful for use as a ceramic. It may help in processes stabilizing zirconium for work in hot spots.

Tungsten in Thermometers

➤ TUNGSTEN may replace platinum in electric thermometers used in industry to measure high heats.

F. R. Sias, J. R. Macintyre and A. Hansen Jr., General Electric Company engineers, told the American Institute of Electrical Engineers that tungsten not only has an extremely high melting point, but also is readily available in the form of high purity ductile wire drawn for light bulb filaments.

The three engineers reported that such a thermometer had been built and, to their knowledge, is the first successful one with stabilities as good as, or better than, platinum.

Since platinum's upper heat-measuring limit is about 1,080 degrees Fahrenheit and tungsten's is around 1,800 degrees Fahrenheit, the new type of resistance thermometer will be able to check heats greater than those that can be measured at present by ordinary resistance thermometers.

Resistance thermometers use a heat-sensing element containing some material that changes its electrical resistance as it gets hotter or colder. Both platinum and tungsten have this property.

Plastics From Boron

➤ NEW PLASTICS, made of boron combined with phosphorus or arsenic, which can be heated to 700 degrees Fahrenheit without damage, are predicted by Prof. Anton B. Burg and his associates at the University of Southern California, Los Angeles.

Boron hydride was mixed with a hydrogen compound of phosphorus or arsenic. When hydrogen was driven off, low polymers resulted, which, Prof. Burg is confident, can be converted to high polymers withstanding more severe heating than any present commercial plastics.

Rare Minerals From Mexico

➤ A NEW MINERAL, probably one of the rarest in the earth's crust, has been discovered and described by Dr. George Switzer, geologist at the Smithsonian Institution, Washington, D. C.

Named ordonezite in honor of a Mexican geologist, the late Dr. Ezequiel Ordonez, the mineral was found in a Mexican tin mine. It is a combination of the elements zinc, antimony and oxygen in the form of tiny glassy-brown crystals.

The rediscovery of an even rarer mineral, mosesite, in Mexico has enabled geologists to analyze the mineral for the first time.

Dr. William F. Foshag, head

curator of geology, has found that mosesite is a combination of mercury, nitrogen, chlorine and water in a type of chemical bond never found in nature before. The nitrogen molecule is an ion hooked to mercury in a bond unique in nature.

Mosesite was first found in Texas about 40 years ago, but the quantity was so small geologists could not analyze the sample. The rediscovery was made in a Mexican mercury mine.

How Mercury Ore Deposits

➤ EXACTLY how nature deposits mercury ores has been discovered by two geologists at the University of California at Los Angeles. This promises to aid in discovering new sources of this strategic mineral.

Frank Dickson and Dr. George Tunnel have established that cinnabar (mercuric sulfide), chief mineral source of mercury, is precipitated when solutions containing mercury sulfide and sodium sulfide are neutralized or diluted with water.

Evaporation actually increased the amount of dissolved cinnabar, although continued evaporation eventually precipitated the mercury. However, this was not in the form of cinnabar but in that of an easily redissolved double salt.

This work is the first to definitely establish the precipitation curve of cinnabar at a fixed temperature. The study is one step in a series tracing the course of mercury compounds in naturally occurring solutions to their final ore deposit form.

Further improvements in the understanding of the origin of mercury deposits are expected to result from the combined field and laboratory studies of economic geologists and geochemists.

The U.C.L.A. study is being performed under a contract with the Office of Naval Research.

Iron Chemicals Produce Greener Trees

➤ IRON-CONTAINING chemicals known as "chelating agents" can make pallid trees turn a rich green and cause plants to survive in barren soil with irrigation water previously too alkaline.

Drs. Arthur Wallace, C. P. North, A. M. Kofranek and O. R. Lunt of the College of Agriculture at the University of California at Los Angeles report that much of the pallor in trees growing in Southern California and other semi-arid areas is due to a condition known as chlorosis, resulting from excessive lime in the soil.

Treating lime soils with these chemicals controlled the chlorosis effectively. The trees became green and stayed green for several months without additional treatment.

For ornamental plants the treatment is very economical. No economic data are available on the use with commercial fruit trees.

Technical nicknames for the "chelating agents" are EDTA, DTPA and HEEDTA. They should be thoroughly watered into the soil and then normal irrigating procedure followed. Excessive applications can result in leaf burning similar to that caused by excessive use of fertilizers.

Three Sets of Group VIII Triads

Analyzing For All the Elements

➤ WHILE the compounds of iron, cobalt and nickel resemble each other very much, they are also much like those of manganese and copper. Mendeleeff simply swept the three left-over metals into an eighth group because they did not fit into the seven classifications into which the lighter elements fall.

As the properties of the elements became better understood and the Periodic Table reached its present form, ruthenium, rhodium and palladium assumed their places as the second set of three elements in Group VIII, and osmium, iridium and platinum as the third.

Nevertheless, the grouping is artificial, and many modern Periodic Tables list the metals from scandium through arsenic, and their analogues in the heavier series, all in one line as transition elements.

The most remarkable property of iron, cobalt and nickel is that of ferromagnetism. This phenomenon must have been observed early, as it characterizes "lodestone," one of the natur-

Group VIII. Elements in Test Reactions

	HCl	H_2S	$(NH_4)_2S$	$(NH_4)_2CO_3$	Special Test
Fe	....	....	FeS	....	Blue color with $K_3Fe(CN)_6$ Red color with KSCN
Co	....	....	CoS	....	Prec. as potassium cobaltinitrite
Ni	....	....	NiS	....	Red prec. with dimethylglyoxime
Ru	....	Prec. not dissolved by $(NH_4)_2S$	....	....	NH_4OH prec. Ru_2O_3 KSCN gives red color, violet on heating
Rh	....	Prec. not dissolved by $(NH_4)_2S$	....	....	Potassium rhodic nitrite is insoluble in alcohol. This separates Rh from Ru.
Pd	....	Prec. not dissolved by $(NH_4)_2S$	....	....	KI prec. black palladious iodide, soluble in excess, giving dark brown color.
Os	....	OsO_2 not dissolved by $(NH_4)_2S$	....	....	Perosmic acid, OsO_4, is volatile.
Ir	....	Ir_2S_3 dissolves in $(NH_4)_2S$	....	....	Compounds of many colors.
Pt	....	PtS_2	....	....	Prec. as ammonium platinic chloride.

ally occurring ores of iron. Ages passed before magnetism was put to work in the compass. Three centuries more went by before the connection between magnetism and electricity was hit upon. In only the past few years have the fundamental reactions between matter and magnetic fields been investigated. Scientists are just beginning to work out the laws of atom structure to which magnetism furnishes the clue. If iron were a scarce element, or if its atom structure were slightly different, magnetism might be a force of which we would be completely ignorant.

The magnetic properties which are familiar in iron occur even more strongly in cobalt. Nickel shows them to a smaller degree. Both these metals were for a long time confused with iron. They are much scarcer in the makeup of the earth's crust. Nickel, however, occurs regularly in meteoric iron.

The ability of iron to remain in the metallic state over a long period of time, in spite of its chemical reactivity, is the property that has made it a key metal in civilization. Its very familiarity perhaps blinds us to some of its unique qualities.

The rest of the Group VIII elements are scarce. They trend toward the properties of the "noble" metals, until platinum shows many reactions similar to those of gold.

In compounds the tendency of Group VIII elements to form acidic radicals is strong.

Earth's Iron Heart

➤ A SOLID inner core of iron is at the earth's center surrounded by the same metal in a molten state.

This is shown by studies by Dr. J. A. Jacobs of the University of Toronto.

In the beginning the earth was completely molten. Now there is a layer of liquid metal that lies between the crust and a solid center. A mantle of rocky material extends to the surface. Below it there is a region still so hot and under such pressure that it is liquid. At the center there is solid iron.

Solidification of the earth did not begin at the boundary of the iron core and the outside crust of rocky silicates. Instead, Dr. Jacobs' analysis shows that the iron began to become solid at the very center of the earth. This solid inner core continued to grow until the temperature at which loss and gain of heat was equaled (the adiabatic temperature) was the same as the melting point of the iron.

As the earth cooled still further, the rocky layers on the outside solidified, not from the top or surface of the earth, but at the bottom junction between the mantle and the iron core.

Thus, a liquid layer of iron was trapped essentially at its original temperature, insulated above by a rapidly thickening shell of silicates, and below by an already solid iron inner core.

Earthquake waves had indicated previously that at least part of the core of the earth is liquid because no transverse waves pass through the center of the earth. The inner solid iron core begins at a depth of approximately 5,000 kilometers (3,100 miles).

How to Get Rid of Radioactive Wastes?

Modern Middens

Reprinted from Industrial Bulletin *of Arthur D. Little, Inc.*

➤ Even waste disposal is a "hot" problem for the Atomic Energy Commission. Every industrial plant must be careful that its noxious gases, liquids, and solids do not endanger public health, but the unique and persistent character of radioactive wastes presents a disposal problem involving future generations.

Controls for the disposal of the relatively low-level activity from the average research and medical radioisotope user are working well. The problem looms larger for industry in the event that nuclear reactors come into use in the power and chemical industries, because these atomic furnaces or "piles" would accumulate most of the peace-time radioactive wastes. Judging from the total amount of uranium available in the world, the physical mass of the waste products would be small in terms of normal waste disposal volumes. The concentrated wastes, however, are toxic for long periods. Concentrating the residues to a small volume is also difficult. For example, the released radioactive energy heats the waste and may cause undesirable melting, volatilization, etc. Furthermore, while radiation levels from long-lived wastes may be dangerous, they may turn out to be too low for such uses as sterilizing foods and biologicals or starting chemical reactions. The AEC is actively studying possibilities for their use and for convenient disposal, but no conclusions are yet generally accepted. The AEC is responsibe for ensuring national safety on this point and maintains a continuous research program in this field. Also, it denies to unqualified users the right of possessing fissionable or radioactive materials.

Concentrated liquid wastes from some AEC reactors are now stored in underground steel tanks. Corrosion will make eventual replacement of the tanks necessary, and sometimes cooling coils are needed to remove the heat generated by radioactive decay. Industrial use of nuclear reactors will produce much more waste and require more permanent disposal methods, for dangerous levels of activity will persist in some cases for generations. In four years the activity drops to a level one tenth that at six months, but when dealing in large quantities of radioactivity even this level is hazardous and may continue for decades.

Armchair theoreticians would like to shoot hot wastes into outer space, where they can contaminate nothing but a space ship. The general earth-bound approach is to immobilize the radioactivity in some durable solid form that can be hidden away from future generations. For example, concentrated liquid wastes might be used in place of water in making concrete blocks to be buried in an arid spot where they would not introduce ex-

cessive radioactivity into ground water, or the blocks might be dumped into the ocean where they would bury themselves in the muck on the bottom. Fusion in glass or in special clays, followed by burial, is also being considered. Depleted oil wells from one thousand to ten thousand feet deep might hold raw liquid radioactive wastes. The wells would be gas-tight, and migration of radioactive products through rock strata would be slow.

To avoid transportation problems, it would be better to bury the blocks near the producing site; in this event, care would have to be taken to insure that hazardous amounts of radioactivity were not added to the local water supply.

Short-lived isotopes which lose half their radioactivity in a few hours or days may be flushed into a city sewer system under prescribed conditions. Many current users of such materials, including hospitals, prefer simply to set the waste products aside to die a natural death, still safe in their protecting containers.

Vortex Tube May Have Supersonic Use

➤ Scientists in the physics department of Cornell Aeronautical Laboratory, Inc. in Buffalo, N. Y., may be on the trail of a new instrument that will play a big role in supersonic research.

The instrument is a vortex tube. It measures the temperature of air around an airplane. It compensates for the "ram heating" of air and, in tests, gave temperature readings accurate to within one degree Centigrade.

The vortex tube is an extremely simple device. It has no moving parts. A heat-sensing element inside produces direct temperature readings for the scientists.

Conventional vortex tubes separate an air stream into a cold and a warm air stream at lower pressure. The modified tube, however, does not actually separate the cold from the warm air. Instead, it keeps a stable core of cold air inside the tube. This core of air yields the temperature of the "free" air around the plane.

At 600 miles an hour, a plane flying just above ocean waves may be warmed 30 degrees Centigrade around its wings and tail because of the heat released by compressed air. At supersonic speeds the heating rises sharply. Now that the so-called "sonic barrier" has been cracked, many aeronautical scientists are hotly pursuing a solution to the "thermal barrier" problem.

"Supersonic heat" has become imposing at speeds flown by supersonic research aircraft today. Great refrigeration systems have been installed in some of the planes to keep their pilots from "frying."

The vortex tube some day may prove valuable as an instrument needed to help scientists chill the effect of the thermal barrier. Scientists here, however, point out they still must learn how the tube works under supersonic conditions, how it is affected by icing and altitude changes, and how it should be mounted on airplanes.

Patents Granted For Chemical Inventions

Discoveries Based on Chemistry

Copies of patents may be obtained by writing the Commissioner of Patents, Washington 25, D.C. Order by number and enclose 25 cents for each patent ordered, in coin, money order or Patent Office coupon (but not stamps).

Ore Recovery Method

➤ A NEW, efficient and economical method for recovering molybdenite, the ore from which the molybdenum metal vital to jet aircraft engines is made, is described in a recent patent.

Molybdenite is a plentiful ore but it is usually found in small quantities with other metals such as copper and iron. The separation of the ore from the other metals has been a major problem in the past.

Lyle M. Barker, Clifton, Ariz., and Orel E. Young of Morenci, Ariz., have devised a method which begins with a copper concentrate containing .25% of molybdenite and through six chemical cleaning operations produces an 85% molybdenite concentrate.

At high temperature molybdenum is one of the strongest of metals. It has a melting point of 4,760 degrees Fahrenheit and is widely used in jet engines and turbines. The new method, patent No. 2,664,199, was assigned to Phelps Dodge Corporation, New York.

Heat-Operated Door

➤ A DEVICE that uses radiated body heat to open doors to hotels or restaurant kitchens received patent No. 2,665,129. It consists of a "thermistor," a device whose electrical resistance changes sharply with fluctuations in temperature.

Concealed near the door to be opened, the sensitive thermistor gathers infrared heat waves radiated from human flesh or automobile engines. When the heat falls upon the thermistor, its resistance changes. This upsets a delicate electrical balance, triggering the air motor on the door.

Inventors Vernon Durbin of Waban and Charles T. Button of Needham, Mass., state that the door will remain open until the person, or automobile, passes through the doorway. The inventors assigned their patent to the National Pneumatic Co., Inc., of Boston.

Bomb For Forest Fires

➤ A FIRE extinguishing bomb that can be dropped from an airplane on devastating forest fires has been invented.

The body of the bomb is constructed to hold carbon dioxide or water. When it strikes the earth the explosion breaks the shell and forcibly spreads the extinguishing agent over a large area.

The inventor, Lee I. Talbot of Livermore, Calif., stated that the bomb may also be used to fight oil fires.

Equipped with tail fins like the bombs of warfare, the fire extinguishing bomb can be dropped with accuracy by planes into fires inaccessible to human firefighters. The device was granted patent No. 2,665,768.

Auto Cooling Attachment

➤ MOTORISTS now using their heaters to tame a cold winter can use an attachment recently patented to convert hot-water type heaters into auto air conditioners for the hot weather driving in July and August.

Chester A. McCarty of Palm Springs, Calif., received patent No. 2,667,045 for his air conditioner.

A small refrigerating unit with a compressor placed in the engine compartment of the auto is used to cool water which is circulated by a pump through the heater. Both the compressor and the water pump can be made to run with electric motors or off the auto engine.

Heart of the invention is an evaporator unit where the pipe containing the cold refrigerant is contained inside the water pipe. The two pipes are wound in a spiral shape to achieve maximum cooling of the water.

Mr. McCarty lists as an advantage of his cooling system that the refrigerant liquid is never inside the cab of the automobile where fumes or leaks might be dangerous to passengers.

Rust Preventive in Gas

➤ AN ADDITIVE for gasoline which prevents rust in tanks and fuel lines has been invented by Milton P. Kleinholz of East Chicago, Ill.

The preventive is a carboxy acid made by oxidation of microcrystalline wax, a petroleum derivative. When added to gasoline in small amounts it inhibits rusting of iron and steel surfaces.

Rust is caused in tanks by dissolved moisture in the gasoline itself, and condensation as the temperature changes. Mr. Kleinholz states that his preventive has no noticeable effect on other properties of gasoline.

The invention, patent No. 2,667,408, was assigned to the Sinclair Refining Co. of New York.

Raises Oil Well Output

➤ A SOUND producing device, designed to raise the output of oil wells, was a recent patent granted by the U.S. Patent Office.

Coupled to the oil-bearing sandstone, the device sets up standing waves of sound that generate heat in the rock, creating gas pressure and lowering oil viscosity. The sound vibrations, which may be beyond the range of human hearing, also help tiny oil droplets to smash through barriers of water which restrict oil yield of a formation.

Albert G. Bodine Jr. of Van Nuys, Calif., states that these actions of the sound waves cause more oil to flow from the oil-bearing formation. He points out that oil wells frequently are abandoned for economical reasons when only one-third of the well's potential has been extracted from the ground.

His device, which received patent No. 2,667,932, is a mechanical, electrical or hydraulic sound generator on the ground. It is capable of delivering high-powered sound waves into the well, or a bore hole connecting with the oil-bearing rock. The connection can be through a length of flexible steel pipe whose end is terminated in a collar of concrete or sand which touches the oil-bearing formation.

Mr. Bodine states that his invention can be used to increase the total oil output of a single well or, if installed in an abandoned well, to increase the general flow in nearby operating wells.

Machinable Titanium Alloy

➤ TITANIUM is a strong, relatively lightweight and heat-resistant metal. It is finding increasing favor among aeronautical engineers who need metals that can withstand the high temperatures generated by air friction at supersonic speeds. But titanium's workability in the machine shop has been a problem.

Two alloys of titanium and arsenic have just been patented. Both may prove useful to the metallurgist and aeronautical engineer. Readily machinable, one alloy consists of a titanium base combined with 0.05% to 0.65% arsenic. The second alloy contains 0.1% to 0.6% arsenic.

Both alloys yield a material having the mechanical properties of titanium. Both are ductile, hard and easier to machine than the unalloyed titanium.

Prepared in an arc-melting process under an argon atmosphere, the alloys were developed by Robert I. Jaffee of Worthington, Ohio, who assigned his patent, No. 2,668,108, to the Kennecott Copper Corp. of New York.

Electricity From the Tide

➤ A MEANS of harnessing the rising and falling tides of the ocean to produce electric power was patented by Vernon W. Howell of Albany, Calif.

Floats in a basin open to the sea are arranged so that they generate power as they rise and fall. To make the operation more efficient and continuous, cisterns which store water are connected to tanks above the floats so that the float may be made to sink and rise during the periods of low water.

Once at the bottom of the basin, the water in the tank is expelled and the float rises. This motion of the float drives an air compressor through gears. The generators are run by compressed air motors.

The invention received patent No. 2,668,918.

Color Television Tube

➤ A FOUR-COLOR television tube invented by Lewis B. Headrick of Lancaster, Pa., and assigned to the Radio Corporation of America received patent No. 2,669,671.

In a typical television tube, four electron guns are arranged to sweep the face of the tube, activating white, red, blue and green phosphors.

The inside face of the tube is coated with the white phosphor. Arranged against this is a honeycomb of hexagonal sections. Two of the six inside faces of each section are coated with red phosphor, two with blue and two with green.

The tube is designed to take advantage of mixed high frequency signals, the higher frequencies transmitting the details of the picture and the lower the color components.

Industrial Ear Plug

➤ THE EFFECT of industrial noise, which has been blamed with reducing worker efficiency, might be minimized if the labor forces in noisy plants wore sound absorbing ear plugs like the one patented this week by Charles Leight of Los Angeles.

The ear plug would be made of rubber. It would be filled with a spongy sound-absorbing material that would reduce the effect of loud crashes, yet permit almost normal conversation to get through to the ear. Mr. Leight, who received patent No. 2,672,863 on his device, said airplane pilots could wear the plugs comfortably under earphones.

Proudly Presented

➤ PORTABLE container for radioactive materials is made of lead clad steel with a removable lead plug for the opening. It is tubular with stabilizing lugs at the bottom and a lifting lug along the top. It can also be produced to order in other shapes and all sizes. It is manufactured by Knapp Mills, Inc., New York, and sold under the name "Raysist vault."

➤ THE KRUGER Spectrophotometer is a new type, designed around a wedge interference filter. It combines the features of narrow band width, simple operation and high accuracy with low cost. Additional details are available from Harold Kruger Instruments, P.O. Box 164, San Gabriel, Calif.

➤ DIRECTIONS for making weight determinations in unusual situations, including handling radioactive samples when the maximum protection is not needed, are given by the Fisher Scientific Co. for use with their Gram-atic Balance. This is a single-pan, constant-load, constant-sensitivity, direct-reading balance, in which there is no personal handling of weights. Two ports in the floor of the balance case allow use of a special yoke and hook by which the sample to be weighed can be suspended, or the instrument can be used in the conventional manner. Further information may be obtained from the company at 717 Forbes St., Pittsburgh 19, Pa.

➤ THE BORDEN Co. has added two new products to its line of casein paint materials. "Polyco 556" is a new latex, a butadiene-styrene which is stable to freezing and thawing. "Polyco 522" is a new polyvinyl acetate emulsion with outstanding water resistance and color fastness. Information about the new products may be obtained from American Polymer Co., Peabody, Mass. Information pertaining to the caseins is available from The Borden Co., Chemical Division, 350 Madison Ave., New York 17, N.Y.

➤ FREON-13, because of its nonflammable properties, is finding new use in hermetic-type compressors in low temperature work. It takes the place of ethane and ethylene, formerly used, both of which are fire risks. Freon-13 is monochlorotrifluoromethane. It is being marketed by E. I. du Pont de Nemours & Co., Wilmington, Del., and will be stocked at their warehouses at Carney's Point, N.J., and at East Chicago, Ind.